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1. Title of the Invention: Liquid crystal display panel
   Patent Application Sho 53-104210
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SPECIFICATION

1. Title of the Invention

Liquid crystal display panel

2. Scope of Claim for Patent

1. In a liquid crystal display panel utilizing a semiconductor substrate provided with a plurality of active elements and passive elements, said liquid crystal panel characterized in that said semiconductor substrate is provided with electrode films in a matrix form corresponding to said active elements and said passive elements over a surface of the semiconductor substrate, which surface has been planarized, and a surface of said semiconductor substrate is covered with an orientation treatment film.

2. The liquid crystal display panel of claim 1, wherein the planarized surface of the semiconductor substrate is formed by coating an insulating material in varnish form at a film thickness of 1 to 5μ on the semiconductor substrate having big irregularity.

3. The liquid crystal display panel of claim 1, wherein the orientation treatment film on the surface of the semiconductor substrate is an oblique evaporation film of SiO.

4. The liquid crystal display panel of claim 1, wherein the liquid crystal has a twisted nematic structure.

5. The liquid crystal display panel of claim 1, wherein the liquid crystal comprises polygenetic color and nematic liquid crystal.

"Detailed Description of the Invention"

The present invention relates to a liquid crystal display panel. Further, the present invention relates to a surface configuration and a surface treatment of a semiconductor substrate which is utilized for one of substrates constituting a display cell.

Recently, the display device is extremely advanced. Especially, the display device using liquid crystal has many advantages of low voltage driving, low power, thin type and long life. In these days, it is utilized for various kinds of display devices such as wristwatch, pocket calculator. On the other hand, as a practical uses, the display device is applied for character display and television by making the best use of the above mentioned advantages of the liquid crystal display device. In this way, in case that the number of rows and columns of matrix display is big, it is effective to statically drive a liquid crystal utilizing active elements, which are prepared on a semiconductor substrate as one of the substrates constituting the display cell. The present invention relates to this static drive type liquid crystal display device.

Fig. 1 shows a conventional liquid crystal display panel. Fig. 1 shows a structural drawing of the conventional liquid crystal display panel. Reference numeral 1 in the figure shows a semiconductor substrate comprising active elements or passive elements. A liquid crystal driving electrode 2 is prepared on a surface of a semiconductor substrate in a form of matrix. Reference numeral 5 shows a spacer, and a transparent conductive film 4 is formed on an upper side glass plate 3. Reference numeral 6 shows a liquid crystal. Fig. 2 shows a cross sectional drawing of a semiconductor substrate. In Fig. 2, a region enclosed with two dot chain line equals to one pixel. One transistor and one condenser are included in one pixel. In the figure, reference numeral 7 shows, for example, a n-type silicon substrate, 8 shows a p-type diffused layer, 9 shows a n^+ type diffused layer, 10 shows a field oxide film, 11 shows an SiO_2 film, 12 shows a doped polysilicon film, and 13 shows a CVD SiO_2 film. 14 is an aluminum film comprising electrode and wiring. 15 is a protective film, which is usually a CVD SiO_2 film. In Fig. 2, the part A is a transistor and the part B is a condenser. As apparent from Fig. 2, in case that the semiconductor substrate is manufactured by a conventional process, a step of approximately 1 to 3 μ is formed on the surface of the semiconductor substrate. The unevenness of the surface is generally large although it depends slightly upon the configuration of the elements embedded in the semiconductor substrate and the manufacturing process. Therefore, as shown in Fig. 2, when an orientation treatment is

conducted on the surface of the semiconductor substrate having big irregularity by oblique evaporation of SiO or the like, there is formed one surface on which the SiO film is formed and another surface on which no SiO_2 film is formed as shown in Fig. 3. In Fig. 3, 16 is the semiconductor substrate having irregularity on the surface thereof. 17 is a direction of evaporation of SiO particles which are deposited by an oblique evaporation at an angle θ = 70 to 89°C and 18 is an SiO film formed on a semiconductor substrate. As apparent from the figure, the bigger the irregurality formed on the surface of the semiconductor substrate 16 is, the smaller the proportion of the surface having the SiO film formed thereon is. If a proportion of the surface having no SiO film is large, this part does not contribute to the actual display. Therefore, the contrast extremely reduces and the function as a display device deteriorates. The present invention removes the defect of the conventional liquid crystal display panel. Referring to the detail examples, the object of the present invention will be set forth in the description.

Usually, the surfaces of two substrates constituting the liquid crystal display panel needs to be treated with a horizontal orientation or vertical orientation treatment depending upon the display mode and the kind of the liquid crystal. There are many methods as an orientation treatment, for example, rubbing process, oblique evaporation, and dipping method using such as silane coupling agent. However, in view of characteristic and homogeneous quality, oblique evaporation process is best. In the oblique evaporation method, SiO or Teflon is evaporated on the substrate in vacuum at an angle of 70 to 89° and thin and long lines are innumerably formed at intervals of several hundreds to several thousands Å(angstrom) on the surface of the substrate in order to conduct the orientation of the liquid crystal. In case of conducting oblique evaporation to glass substrate, an oblique evaporation film 20 is deposited on an entire surface because a surface of a glass plate 19 is flat as shown in Fig. 4. On the other hand, in case that a semiconductor substrate is used, a step of 1.0μ or more is formed on a surface as mentioned above. If a semiconductor substrate having a step of 1.0 μ on the surface is subjected to an oblique evaporation at an angle of 80°, an oblique evaporation film is not deposited on a region of 5.8μ at one side of the step portion. The present invention has been made to solve the problem described above, thereby obtaining the display panel having high contrast and the excellent image quality. Concretely, in case that the surface of the semiconductor substrate which contributes to the display is flatten and conduct an oblique evaporation, it characterized that a ratio of portion having no oblique evaporation film is reduced. Fig. 5 shows a cross-section

al drawing of construction of a substrate having reduced a step on th surface of the semiconductor substrate. Reference numerals 7 to 14 in Fig. 5 corresponds to that in Fig. 2. Reference numeral 21 in Fig. 5 is a layer to flatten the surface of the semiconductor substrate, which is the point of the present invention. Further, as a liquid crystal driving electrode, a transparent conductive film layer or a metal layer 22 is formed on the layer 21. The liquid crystal driving electrode is connected with a lower wiring 14 by through hole. The layer 21 which flattens the surface of the semiconductor substrate may comprise polyimide resin, glass having low melting point, insulating material, or the like. In case that a polyimide resin is used, a polyimide film having a thickness of 1 to 5 μ on the surface of the semiconductor substrate by polyimide varnish and spinner application. In this case, silane coupling agent is applied to a base semiconductor substrate to enhance the adherence between the base film and a polyimide film. Subsequently, it is cured at a temperature of 350 to 550°C. Through holes may be formed by photoetching by using hydrazine solution or NaOH. Then, a liquid crystal driving electrode may by formed. Polyimide is used as a flattening material for the semiconductor substrate because it is superior in heat resistance to other organic resins and it can be formed at a thickness of 10 μ without crack. Furthermore, polyimide is superior in passivation effect. However, the present invention is applied to not only a polyimide film but also a glass having low melting point, for example, a lead glass comprising PbO_2 as a main component, a zinc glass comprising ZnO_2 as a main component or a phosphorus glass comprising P_2O_5 as a main component. If a step of 0.5 μ or less is formed on the surface of the semiconductor substrate after deposition, the above mentioned materials can be sufficient for the present invention. By an oblique evaporation, an orientation film is formed on a surface of the flatten semiconductor formed by the above mentioned process. Thereby, as shown in reference numeral 20 in Figs. 5 and 6, almost all display portions can be treated with an orientation process, so that the contrast of the liquid crystal display panel is remarkably improved and it is possible to obtain a good image of the display panel. In Fig. 6, reference numeral 23 is a semiconductor substrate having a planarized surface, and 24 is a liquid crystal driving electrode. By using the semiconductor substrate having the planarized surface according to the present invention, contrast of the liquid crystal display panel is improved to several times as compared with conventional one.

In the present invention, the substrate having a MOS type transistor is

explained as a semiconductor substrate, however, a substrate having TFTs or a SOS substrate may be used as the semiconductor substrate. Moreover, a semiconductor substrate may be consisting of not only active elements but also passive elements. When a liquid crystal display cell according to the present invention is applied to the liquid crystal display television, it is very effective to obtain a high contrast. In this case, a liquid crystal may be a twisted nematic type having low driving voltage or a nematic liquid crystal is mixed with dichroism color. If a semiconductor substrate having a flatten surface is used, display having an improved contrast can be obtained because the thickness of the liquid crystal can be uniform.

As above mentioned, the present invention relates to the liquid crystal display panel, which is characterized that a surface of the semiconductor substrate used for one side of the display panel is planarized to improve the contrast.

"Brief Explanation of The Drawings"

Fig. 1 illustrates a cross sectional structure of a liquid crystal cell.

Fig. 2 is a cross sectional view showing an irregularity, which is formed on the surface of a conventional semiconductor substrate.

Fig. 3 shows an orientation treatment of a substrate having a big irregularity.

Fig. 4 shows an orientation treatment of a glass having a planarized surface.

Fig. 5 shows a cross sectional view of a semiconductor substrate having a planarized surface in accordance with the present invention.

Fig. 6 shows an orientation treatment of a substrate having a planarized surface.

1---semiconductor substrate	2---liquid crystal driving electrode
3---upper side glass plate	4---transparent conductive film
5---spacer	6---liquid crystal
7---n type silicon substrate	8---p+ type diffused layer
9---n+ type diffused layer	10---field oxide film
11---gate oxide film	12---doped polysilicon film
13---CVD SiO_2 film	14---a second layer wiring
15---CVD SiO_2 film	

16---semiconductor substrate having a big irregularity
17---oblique evaporation direction
18---oblique evaporation film 19---glass plate

20---oblique evaporation film
21---a layer to make a surface of semiconductor to be planarized
22---liquid crystal driving electrode
23---semiconductor substrate having a planarized surface
24---liquid crystal driving electrode

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(54) 液晶表示パネル

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明　細　書

発明の名称　液晶表示パネル

特許請求の範囲

(1) 表示セルを構成する一方の基板に、複数個の駆動素子及び受動素子をマトリックス状に配列した半導体基板を用いた液晶表示パネルにおいて、該半導体基板は表面平滑化処理が施された基板表面上に該駆動素子及び受動素子に対応してマトリックス状に電極が形成されており、かつ該半導体基板表面上に[illegible]処理が施されていることを特徴とする液晶パネル。

(2) 半導体基板表面の平滑化処理は、凹凸の激しい半導体基板上に、1〜5μの膜厚にてガラス状の[illegible]材料を塗布形成していることを特徴とする特許請求の範囲第1項記載の液晶表示パネル。

(3) 半導体基板表面の平滑化処理は[illegible]項記載の液晶表示パネル。

(4) 液晶表示パネル内の液晶は、ねじれネマチック構造を有することを特徴とする特許請求の範囲第1項記載の液晶表示パネル。

(5) 液晶表示パネル内の液晶は、多色性染料とネマチック液晶とから成ることを特徴とする特許請求の範囲第1項記載の液晶表示パネル。

発明の詳細な説明

本発明は液晶表示パネルに関するものである。さらに本発明は、表示セルを構成する一方の基板に用いた半導体基板の表面形状及び処理方法に関するものである。

近年、表示装置の進歩には目をみはるものがあり、中でも液晶を用いた表示装置では、低電圧駆動、低消費電力、薄型及び長寿命を特徴に多くの分野に[illegible]、時計、電卓、[illegible]の表示装置に用いられている。一方液晶表示装置の[illegible]

れている。この様にマトリックス表示の行数及び列数が多くなつた場合、表示セルを構成する一方の基板に単結晶基板を用い該基板上に配置された能動素子により液晶をスタティック駆動する方式が有効である。本発明は、このスタティック駆動型液晶表示装置に関するものである。

従来の液晶表示パネルを第1図に示す。第1図は従来の液晶表示パネルの構造図を示すものであり、図中の1は能動素子もしくは受動素子を含む半導体基板である。半導体基板表面には、液晶駆動電極2がマトリックス状に配置されている。3はスペーサーであり、上側ガラス板5上には透明導電膜4が形成されている。6は液晶である。第2図は、半導体基板の断面図である。第1図の二点鎖線で囲まれた領域が一絵素に相当する。一絵素中には、トランジスタとコンデンサーがそれぞれ1個づつ含まれている。図中の7は、たとえばn型のシリコン基板、8はp型の拡散層、9はn+型の拡散層である。10はフィールド酸化膜、11はSiO_2膜、12はドープドポリシリコン膜である。13は[illegible]膜、14はアルミニウムで電極と配線を成す。15は保護膜であり通常は[illegible]膜である。第2図のA部がトランジスタ部、B部がコンデンサー部である。第2図から明らかな如く、半導体基板上に素子を形成した場合、半導体基板表面には1〜3μの段差ができる。これは、半導体基板に組み込まれる素子の形状及び製造プロセスによつても異なるが一般に、その段差の形状は[illegible]。したがつて、第2図にて示した様な段差の著しい半導体基板を用いて、その表面に、SiO 等の斜め蒸着により配向処理を施した場合、第3図に示す如く、SiO 膜が形成される表面と、SiO 膜が形成されない表面が生ずる。第3図中16は段差部分がある半導体基板、17は、角度70〜85°にて斜め蒸着されるSiO 分子の蒸着方向、18は、半導体基板上に形成されたSiO 膜である。図からも明らかな如く、半導体基板16の段差の傾きが急しければ急しい程、SiO 膜が形成されない部分の占める割合は大きくなる。第3図のように配向用のSiO 膜が形成されない表面が占める割合が大きいと、この部分は液晶の表示に寄与しないため、コントラストが著しく低下し、表示装置としての機能は低下する。本発明はかかる従来の液晶表示パネルの欠点を取り除いたものであり、その目的は、以下具体的な実施例を挙げて説明する。

一般に液晶表示パネルを構成する2枚の基板表面には、液晶の表示方式、種類により水平配向あるいは垂直配向処理が必要である。配向処理にはいろいろな方法がある。たとえばラビング法、斜め蒸着法、シランカップリング剤等のディッピング法がそれである。しかし、特性、性質の均一性などの点から、斜め蒸着法が最もよい。斜め蒸着法はSiO あるいはアルミナ等を真空中で基板に対して、70〜85°の角度で蒸着させ、基板表面に[illegible]（ヤングストリーム）の[illegible]、[illegible]ろ方向の斜め蒸着膜20は、全面に付着する。一方半導体基板を用いる場合、半導体基板は、前述した如く、表面の段差は1.0μ以上にもなり、仮りに1.0μの段差があつた場合、その[illegible]の角度から斜め蒸着すると、段差部の片側5.8μの領域には斜め蒸着膜が形成されないことになる。本発明は、この点を解決するために発明されたものでありコントラストが高くかつ見やすい表示パネルを提供したものである。具体的には半導体基板表面が表示に寄与する領域の段差を平坦化し、斜め蒸着を行なう際、段差によつて、斜め蒸着膜が付着しない領域の占める割合を低減したところに特徴がある。第5図は、半導体基板の表面段差をなくした半導体基板構造断面図である。第5図中の7〜14までの番号は、第2図中の番号と同様している。第5図中の21は、[illegible]

17…溝の延在方向　18…溝の底壁面
19…ガラス板　20…溝の底壁…
21…半導体薄膜を平坦化する層
22…低融点物質層
23…表面が平坦化された半導体基板
24…低融点物質層

以　上

出願人　株式会社　精工舎

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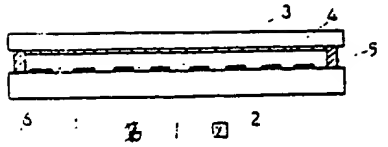
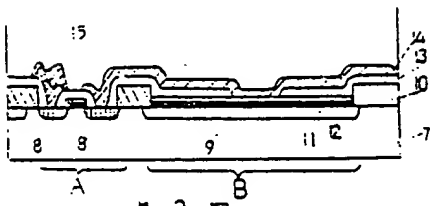
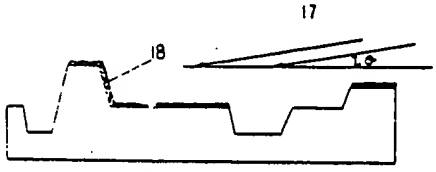


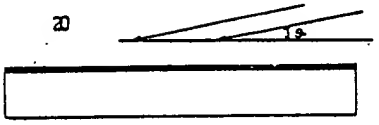
第 1 図



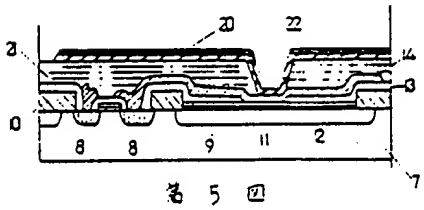
第 2 図



第 3 図



第 4 図



第 5 図